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INTRODUCTION

California is the leading state in the production of cereal hay, and over considerable areas where beef cattle are raised on the range, grain hay is available or can be grown, while the production of alfalfa hay is not possible or feasible. Tame oat hay, barley hay, and wild oat hay constitute the bulk of the cereal hays produced. The last named is a volunteer crop on cultivated lands, often mixed with bur clover and volunteer grain. It is also widely distributed on the lower ranges and can, in many places, be cut for hay.

On several ranches the total feed supply is greatly increased, and its quality retained, by cutting wild oats in the green stage when fully headed and raking it into windrows or bucking it into large piles. When the plants have been allowed to fully mature and the seeds to shatter, there is a decided decrease in nutritional value. Hart and Guilbert[(1)] have pointed out that this is due to the loss of protein and phosphorus and to an increase in fiber content.

In addition to the hay crop many ranches can or do produce considerable quantities of barley, which can be used for fattening cattle.

The *total* slaughter of cattle in California appears to have no marked seasonal variations, but there is a marked seasonal variation in the slaughter of California cattle, and a corresponding variation, therefore, in slaughter of cattle originating in other states. According to Voorhies and Koughan,[(2)] very few slaughter cattle are shipped into California from May to August, a period during which an actual surplus sometimes exists within the state.

The price level from October to March, when supplies of cattle are being drawn from other states, is usually higher than during the heavy runs of California grass fat cattle. The rather sudden changes from shortage to surplus which so frequently occurs makes stabilization of the market difficult.

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The trend of the past toward more and more intensive methods of beef production will probably continue. The continued tendency toward light weight carcasses, the economical gains made by young animals, and the growing necessity of producing more tonnage of beef from a given area of land are important considerations. Fattening of yearling steers in California, though not a common practice, appears to have possibilities where suitable feeds are available and not too high priced. Yearling steers may be put on feed in the summer or fall and marketed between November and March, when the price is ordinarily good. Under favorable conditions, some cattle might advantageously be handled in this way and the others carried over and finished on grass the following spring and summer.

In view of the above facts, it was felt that experimental work on the feeding value of wild oat hay, along with suitable grain rations for fattening yearling steers should yield information which sooner or later would be valuable to cattlemen.

REVIEW OF LITERATURE

In three trials with fattening calves at the Kansas Agricultural Experiment Station during 1925–1928, Anderson[3] showed that a ration of corn, corn silage, prairie hay, and cottonseed meal was considerably less efficient than when alfalfa hay was fed in the combination, but that the prairie hay ration was equal to the one containing alfalfa when supplemented by a tenth of a pound of calcium carbonate daily per steer. In other trials,[4] where no silage was fed, the addition of ground limestone to prairie hay appeared to increase the gains slightly, but the combination of prairie hay and ground limestone was not equal to alfalfa. In this lot, where the supplement was fed, the increase in gain could possibly be accounted for by the slightly greater feed consumption, which might have occurred irrespective of the supplement. The calcium content of the feeds used in these experiments was, unfortunately, not determined.

That the calicum requirement for growth of cattle is not particularly high when phosphorus is adequate was shown by Thieler, Green, and DuToit.[5] They report an increase in live weight of two heifers from about 470 pounds to about 1100 pounds in a period of eighteen months on a ration supplying 8 grams of calcium oxide daily. This constituted a gain of over a pound a day for an eighteen-months period on a ration containing approximately .15 per cent calcium oxide.

PLAN OF THE EXPERIMENTS

Information already at hand indicated that the deficiencies of wild oat hay as compared with alfalfa are low protein, low calcium, and somewhat lower palatability.

Two experiments were conducted—the first during the winter of 1927–28, the second during the winter of 1928–29. The objects of the first trial were as follows:

1. To compare the feeding value of alfalfa hay and wild oat hay in fattening yearling steers.

2. To determine the advantage, if any, of adding a mineral (calcium carbonate in the form of ground oyster shell) in rations containing wild oat hay.

3. To study the factor of palatability and possibly increased gains secured by chopping wild oat hay and adding to it cane molasses.

4. To ascertain how replacing one-half of the alfalfa hay with wild oat hay will affect the gain and finish of the cattle.

5. To determine the value of adding a small quantity of cottonseed meal to a ration of alfalfa hay and rolled barley.

The plan of the second experiment was the same as of the first, except that points 4 and 5 were omitted.

The Cattle Used.—The steers for both trials were purchased from the same herd in Modoc County. Although predominantly Hereford in characteristics, they showed a mixture of Shorthorn blood. They varied widely in individuality as indicated by conformation and quality. The grades varied from low medium to high good and, as a group, probably averaged near the top of the medium grade. They were dehorned after arrival at the feed yards. Although great individual variation made them by no means ideal for experimental purposes, they well represented the type of cattle available to California feeders. The lots were divided as evenly as possible on the basis of weight and individuality. Each group had access to a shed 24 by 32 feet and to an open, paved lot 24 by 40 feet. Ten animals were used in each lot. Figure 1 shows the steers in lot 3 at the close of the experiment and gives an idea of the general quality and condition of the cattle at the time of marketing.

Method of Feeding.—The grain ration was fed first and followed by the hay. The cottonseed meal and ground oyster shell were fed mixed with rolled barley. The chopped hay was placed in a box with a metal lining. The molasses, diluted with an approximately equal quantity of water, was sprinkled on the hay, which was then allowed to stand until the next feeding time.

The steers were given all the hay they would consume. After they were started on feed, the grain ration was fed at an average of about 1¼ pounds for each 100 pounds of live weight in the first trial and about a pound per 100 pounds in the second. All lots had water and salt available at all times.

Fig. 1.—The steers in Lot 3 at the close of the 150-day feeding period. This lot received a ration of wild oat hay, rolled barley and cottonseed meal.

RESULTS OF THE FIRST TRIAL

Preliminary Weights.—The average weight at the shipping point, after a five-mile drive and a 1½ per cent shrink, was 597 pounds. The weight upon arrival at the feed lots was 562 pounds, a 5.78 per cent shrink. The steers were rested a few days and then dehorned. The weather was warm and despite close observation, considerable difficulty was encountered from maggot infestation, which resulted in heavy shrinkage and slow healing. The cattle were started on the experiment three weeks after their arrival, at an average weight of about 557 pounds. The dehorning operation, due to warm weather and flies, resulted in some loss of flesh and the loss of about a month's time.

Feeds Used in the First Trial.—The barley used varied somewhat during the trial; that used during most of the experiment weighed around 41–43 pounds per bushel. It was steam rolled. Good quality alfalfa was used throughout, and wild oat hay of fair quality, not too bright in color, but fine-stemmed and containing no bur clover.

The cottonseed meal was hot-pressed, guaranteed to contain not less than 41 per cent protein although the analysis showed it to contain only 38.28 per cent. The molasses was Hawaiian cane, and the pulverized oyster shell contained approximately 97 per cent calcium carbonate.

The composition of the feeds is shown in table 1.

TABLE 1

Composition of Feeds Used in the First Trial

Feeds	Moisture	Crude protein	Nitrogen-free extract	Ether extract	Crude fiber	Ash	CaO	P_2O_5
	per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
Alfalfa hay	8.85	14.94	36.39	1.15	29.25	9.42	1.21	0.63
Wild oat hay	8.09	7.39	44.61	2.08	28.94	8.89	0.26	0.78
Rolled barley	11.57	10.95	66.70	1.60	6.34	2.84	0.07	0.96
Molasses	18.97	1.90	59.75	0.10	0.05	9.33	0.36	0.025
Cottonseed meal	6.62	38.28	30.29	8.19	9.46	7.16	0.45	3.46

Weights.—The steers were weighed individually three days in succession at the beginning of the experiment, and the average taken as the initial weight. They were weighed at 30-day intervals, and the average of three daily weights at the close of the experiment was taken as the final weight.

Rations Used.—The rations for the various lots were as follows:

Lot 1 Alfalfa hay and rolled barley

Lot 2 Alfalfa hay, rolled barley, and cottonseed meal

Lot 3 Wild oat hay, rolled barley, and cottonseed meal

Lot 4 Wild oat hay, rolled barley, cottonseed meal and pulverized oyster shell.

Lot 5 Chopped wild oat hay, cane molasses, rolled barley, cottonseed meal, and pulverized oyster shell

Lot 6 Wild oat hay in the morning, alfalfa hay at night, rolled barley, and cottonseed meal.

As there was no marked difference in appetite, all lots were fed the same quantity of concentrates except lot 1, which went off feed during the last 30 days.

The average ration for each 30-day period of a typical lot is shown in table 2.

The lots receiving alfalfa hay ate about one pound more hay throughout the experiment than those fed wild oat hay. The lot fed chopped oat hay and molasses ate 12 pounds of hay daily throughout most of the experimental period.

The detailed results are given in table 3.

TABLE 2

AVERAGE DAILY RATIONS BY 30-DAY PERIODS, LOT 3

Period	Wild oat hay	Rolled barley	Cottonseed meal
	pounds	*pounds*	*pounds*
First 30-day period	9.96	4.13	1.13
Second 30-day period	10.43	6.23	1.88
Third 30-day period	10.46	6.99	2.00
Fourth 30-day period	10.38	7.99	2.00
Fifth 30-day period	8.00	9.69	2.00

TABLE 3

RESULTS OF 150-DAY FEEDING EXPERIMENT IN FATTENING YEARLING STEERS

	Lot 1*	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
	pounds	*pounds*	*pounds*	*pounds*	*pounds*	*pounds*
Average initial weight	557	557	557	557	557	557
Average final weight	855	865	862	857	845	847
Total gain per steer	298	308	305	300	288	290
Average daily gain	1.99	2.06	2.03	2.00	1.92	1.94
Average daily ration:						
Rolled barley	8.32	7.77	7.01	6.99	4.03	7.80
Cottonseed meal		0.98	1.80	1.80	1.98	0.98
Calcium carbonate				0.17	0.17	
Molasses					2.86	
Alfalfa hay	10.91	10.97				5.52
Wild oat hay			9.86	9.79	11.63	5.48
Hay refused	0.36	0.25	0.40	0.47	0.04	0.06
Feed for 100 pounds gain:						
Rolled barley	419	378	345	349	209	402
Cottonseed meal		47	89	90	103	51
Calcium carbonate				9	9	
Molasses					149	
Alfalfa hay	550	534				285
Wild oat hay			485	490	605†	283
Total concentrates	419	426	434	440	462	453

* Ten steers in each lot. † Chopped hay.

Discussion of Results.—The difference in gains made by the various lots is not significant, for it may be attributed to variations in animals within the lots. The steer making the least gain of the 60 head is in lot 5, and the next lowest is in lot 6. If these two steers were omitted and the gains calculated on the remaining nine head, the average would be brought up to that of lots 1, 2, 3 and 4.

The rate of gain may be considered fairly representative of the results to be expected in feeding yearlings of the quality used in this experiment. A good many of these steers were somewhat rangy, lacking in width, and deficient in hind quarter. This experiment and others demonstrate that steers lacking in breeding reach the limit in

economical gains more quickly than well bred cattle. The better grades can be carried to higher condition more economically. The 10 best steers of the 60 head gained 2.44 pounds daily, while the 10 poorest gained 1.36 pounds.

Table 4 shows the average gains by 30-day periods.

TABLE 4

Average Daily Gains by 30-Day Periods

	Period 1	Period 2	Period 3	Period 4	Period 5
	pounds	*pounds*	*pounds*	*pounds*	*pounds*
Lot 1	3.18	2.22	2.34	1.85	0.32
Lot 2	2.42	2.56	2.09	2.01	1.18
Lot 3	2.69	2.55	2.14	1.76	1.00
Lot 4	2.65	2.48	1.97	1.39	1.49
Lot 5	2.56	2.31	1.71	2.00	1.01
Lot 6	2.66	2.13	2.05	1.23	1.60

The steers apparently reached their limit for economical gain at 120 days. During the last 30 days the concentrate ration was increased to 12 pounds a day in an effort to produce satisfactory finish. The gains were, however, very low and costly. Lots 4 and 6, which made the lowest gains during the fourth period, gained more than the others during the last 30 days.

Slaughter data.—Table 5 shows the total selling weight for each lot, the total warm dressed weight, the estimated cold dressed weight, the dressing percentage on the warm basis, and the estimated dressing percentage on the cold basis. The selling weight was the final weight at the end of the experiment, minus a 3 per cent shrink. Packers usually count on a 2 per cent shrink in the cooler; hence the estimated cold dressed weight has been calculated on this basis.

TABLE 5

Data on Dressing Per Cent: First Experiment

	Selling weight, pounds	Warm dressed weight, pounds	Cold dressed weight, pounds	Dressing per cent, warm basis	Dressing per cent, cold basis
Lot 1	8,291	5,055	4,953	60.96	59.74
Lot 2	8,393	4,998	4,898	59.55	58.36
Lot 3	8,361	5,029	4,928	60.15	58.94
Lot 4	8,310	5,039	4,938	60.64	59.42
Lot 5	8,199	4,982	4,882	60.76	59.54
Lot 6	8,219	4,953	4,854	60.26	59.06

The above figures again show no significant difference between the lots, the variation in dressing percentage being influenced by "fill" to

a greater extent than by any difference in condition of the animals. The final weight of lot 1 was somewhat less than that of lot 2, but the carcass weights were in the reverse order. Lot 1 had been off feed during a part of the last 30 days and were not so well "filled" as normally; in addition, this lot decreased in weight each day of the final three weights, while lot 2 weighed practically the same each day. This again indicated a greater fill in lot 2 steers and a lower dressing percentage. The remainder of the lots weighed about the same on each of the three days, and the small differences in dressing percentage are probably not significant. All lots, although not in high condition, dressed fairly high, probably because many of the steers were shallow-bodied, resulting in light offal.

RESULTS OF THE SECOND TRIAL

The second trial, four lots of ten steers each were used. The animals were heavier than those used in the first trial and were fed 120 days instead of 150.

Preliminary Weights.—The average weight at the shipping point, after a five-mile drive and a 1½ per cent shrink, was 716 pounds. The steers arrived in Davis after a particularly good run of 36 hours. The weight at the feed lots after watering, but before feeding, was 688 pounds, or a shrink of 3.9 per cent. After being fed hay and a small allowance of grain for 8 days, they were divided into lots, and the experiment began. The average initial weight was 715 pounds, or only one pound less than the buying weight, the shrinkage being mostly a matter of fill.

As the weather was warm and flies were numerous at the start of the experiment, dehorning was delayed until favorable weather. It was felt that this procedure might not seriously affect the comparative data from the various lots and might yield interesting information regarding the loss from dehorning under favorable conditions. It was realized, however, that this procedure would render of less value the data on feed required for 100 pounds of gain.

On account of federal accreditation of the breeding herds, the University is limited in its purchase of feeders to a few counties in the tuberculosis-free area, where usually few feeder cattle are for sale and where dehorned cattle could not be bought for the experiment. The complications resulting from dehorning were therefore unavoidable. Figure 2 shows the steers in lot 3 of the second experiment during the first 30 days and before dehorning. The variation in quality and conformation is shown in this photograph.

Fig. 2.—The steers in Lot 3 of the second experiment during the first 30 days and before dehorning.

Data on Dehorning.—The steers were started on experiment October 17 and were dehorned November 23, or one week after the close of the first 30-day period. The weather was cool and frosts had destroyed or reduced the activity of most of the flies, so that no trouble was encountered from this source. The average weights of the steers in each of the lots immediately before dehorning and 10 days later are shown in table 6.

TABLE 6

Effect of Dehorning

	Weight before dehorning	Weight 10 days after dehorning	Gain or loss	Gain for 30-day period
	pounds	*pounds*	*pounds*	*pounds*
Lot 1	798	796	− 2	40
Lot 2	789	790	+ 1	26
Lot 3	793	780	−13	27
Lot 4	787	770	−17	24
Average	792	784	− 8	29

Apparently there was a decided difference in the effect of dehorning on lots 3 and 4 as compared with 1 and 2 ten days after dehorning. For the 30-day period lots 2, 3, and 4, showed very little difference in the total average gain but lot 1 gained considerably more. The

average gain of 29 pounds per steer, slightly under a pound a day, is about half what would normally be expected on the rations consumed. Roughly, the cost of dehorning may be estimated as equaling the cost of gains over a 30-day period under normal conditions, since the cost of gain was practically doubled. This cost is greater, of course, in the feed lot than on the range, where cheaper feed is involved. The data indicate that dehorning under favorable conditions causes a loss of about 15 days' time or of half the normal gains over a period of 30 days.

TABLE 7

RESULTS OF 120-DAY FEEDING EXPERIMENT IN FATTENING YEARLING STEERS

	Lot 1*	Lot 2	Lot 3	Lot 4
	pounds	*pounds*	*pounds*	*pounds*
Average initial weight	711	714	714	712
Average final weight	924	894	908	889
Total gain per steer	213	180	194	177
Average daily gain	1.78	1.51	1.61	1.47
Average daily ration per steer:				
Rolled barley	8.31	6.48	6.49	4.07
Cottonseed meal		1.83	1.82	2.01
Molasses				3.36
Calcium carbonate			.15	
Alfalfa hay	14.14			
Wild oat hay		13.00	12.97	12.26
Feed for 100 pounds gain:				
Rolled barley	467	430	402	276
Cottonseed meal		121	113	137
Molasses				228
Calcium carbonate			9	
Alfalfa hay	795			
Wild oat hay		864	803	834

* Ten steers in each lot.

Feeds Used in the Second Trial.—The feeds used in the second trial were practically the same quality as in the first. The wild oat hay though somewhat brighter in color was coarser-stemmed than that used in the first experiment. It contained a small amount of barley, but no bur clover.

Method of Feeding.—The method of feeding was the same as in the first trial except that a higher proportion of roughage and less concentrates were used. The concentrates were fed at a level of about one pound per 100 pounds live weight. The detailed results are given in table 7.

Discussion of Results.—In the second experiment the variation of individuals within each lot was great. The above data make it appear that the alfalfa hay and rolled barley ration (lot 1) was superior to

the other rations, and that the addition of calcium carbonate increased gains by a tenth of a pound a day. A careful study of the gains made by individual steers within the lots and a computation of the probable error resulting from variation show, however, that the total average gain by lot 1 of 33 pounds more than lot 2 is only a little over twice the probable error and is therefore only an indication that the difference results from the ration and not from other factors. The probable error of the difference in the average gain between lots 1 and 2 was 13.8 pounds and the actual difference only 14 pounds. The difference has therefore no significance. The poorer showing of lot 2 as compared with lot 3 appears to be caused entirely by three particularly low-gaining steers, rather than by the lack of oyster shell in

TABLE 8

Average Daily Gains by 30-Day Periods

	Period 1	Period 2*	Period 3	Period 4
	pounds	*pounds*	*pounds*	*pounds*
Lot 1	2.51	1.35	2.78	.48
Lot 2	2.24	.86	2.07	.86
Lot 3	2.55	.88	2.22	.81
Lot 4	2.40	.79	1.89	.79

* The steers were dehorned during this period.

the ration. The low gain of lot 4 is explained in the same way: two steers in this lot made very poor gains, one of only 81 pounds, or 96 pounds below the average for the lot.

The amount of feed for 100 pounds of gain, particularly the roughage, is higher than in the first trial because of a lower rate of gain and a higher proportion of roughage in the rations.

Table 8 shows the gains by 30-day periods.

The steers in this experiment had about the same finish at 90 days as the steers of the previous trial at 120, because of the heavier weight at the start. It is interesting to note how all lots in both experiments decreased in gains during the last 30 days. As in the case of the previous trial, lot 1, which made the greatest gain up to the last 30 days, gained the least during that period. No reason was apparent for its extremely light gain, as all animals were on feed and the average ration consumed daily was 11 pounds of rolled barley and 13 pounds of alfalfa per steer. They had, however, made a large gain the previous month and may have had an abnormal fill then. The conditions and time of weighing were, however, uniform for all lots throughout the experiment. The strikingly similar results

in both trials give weight to the observation that steers of this quality reach the limit of economic gains very suddenly. Financial results of attempting to obtain a higher finish are apt to be disappointing.

Slaughter Data.—Table 9 shows the total weight at the end of the trial, the warm dressed weight of the carcasses, and the dressing percentages for each of the lots. The cattle were shipped eight days after the close of the experiment, and all lots had increased in weight. The dressing percentage was taken on the basis of the final weights of the trial, since individual weights were not taken immediately before shipping, and the average of the three final daily weights was considered more accurate for comparative purpose than a single weight. The dressing percentage is fairly high on the full basis because of some increase in carcass after the weights were taken.

TABLE 9

DATA ON DRESSING PER CENT: SECOND EXPERIMENT

	Live weight, pounds	Carcass weight, pounds	Dressing per cent, warm basis
Lot 1	9,240	5,474	59.24
Lot 2	8,943	5,305	59.32
Lot 3	9,077	5,385	59.32
Lot 4	8,885	5,200	58.52

The dressing percentage were about the same as in the previous trial. Lots 1, 2, and 3, produced the same yield, while lot 4 was 0.8 per cent lower. All lots were sold for the same price per pound in both experiments.

Grading of Steers and Carcasses.—The steers were graded individually as feeders by the author at the beginning of the trial. At the end they were graded as slaughter cattle by a committee of three, composed of W. E. Schneider and E. T. Forsling, Federal-State Livestock Market News Service, San Francisco, and the author. The results are summarized in table 10.

In order to make rather fine distinctions in grading the individuals, each grade was divided into three sub-grades, i.e., high good, average good, low good, etc. The grading in general showed very fine agreement among the judges. The committee agreed on 30 out of the 40 head, and the variance on the remaining 10 head was with one exception within the limits of one-third of a grade. Several steers graded low good as feeders were not sufficiently finished to go in that grade as slaughter cattle and were graded at the top or the average of the medium grade.

It is realized that live cattle may at times change in appearance from one day to the next to an extent that would slightly alter the grading. It is also recognized that not all animals placed in a certain grade as live cattle may be assigned to the corresponding carcass grade because of bruises or faults not apparent in the live animal. Individuals doing the grading introduce a further variation. A careful appraisal of the individual animals and carcasses, together with the dressing percentage and total gains, seems a better basis for comparing one ration with another in regard to finish and market

TABLE 10

Summary of Grading of Steers and of Carcasses

			Lot 1, number of head	Lot 2, number of head	Lot 3, number of head	Lot 4, number of head
Feeder grade	Good	High	1			1
		Average	3	2	2	
		Low	2	4	3	5
	Medium	High	2	2	3	3
		Average	2	1	2	1
		Low		1		
Slaughter grade	Good	High			1	
		Average	2	2	1	3
		Low	2	1	1	1
	Medium	High	1	1	2	3
		Average	5	6	5	1
		Low				2
Carcass grade	Good	High		1		
		Average	2	2	1	2
		Low	3	1	2	1
	Medium	High	2	2	2	1
		Average	3	4	3	5
		Low			2	1

value than selling price alone. Particularly is this true on the Pacific Coast, where the price spread between grades is narrow and where small differences in finish are not recognized in a price differential. In the report of feeding trials where appraisal by a market representative is used as an index of finish, an apparent inconsistency not infrequently exists between appraisal value and the total gain in live weight. More careful individual study of the animals comprising the lots in such cases and a record of actual sales of the carcasses might reveal that these price differences resulted from factors other than the effect of the ration, or perhaps were not justified at all from the standpoint of actual packing house receipts.

No great difference in the lots is revealed by the grading. The carcasses from lot 1 seemed, on the average, slightly better covered. In general the carcasses were characterized by a covering of fat approximately ¼ to ⅜ of an inch in thickness over the back and loin. On the best steers there was a thin covering of fat on the round, which is one of the last places to cover. In most of the steers, rounds were deficient in covering. There was very little waste, and the kidney fat was light. Most of the carcasses were somewhat angular, heavy in front, and deficient in loin and round. A number of carcasses—somewhat lighter than the average, smooth but very light in kidney fat, and all grading as medium because of conformation and finish—sold for a cent more per pound than those better covered.

These and other observations have indicated that high condition does not necessarily increase the carcass price of this class of cattle. The packer, when buying live cattle, can, however, pay somewhat more for those carrying higher condition, because of greater yield. The apparent failure of carcass buyers to make a price differential for high condition may be logically attributed to the trade demand which they supply. Fat intermingled with the lean, commonly called marbling, is generally associated with tenderness and flavor of beef. Frequently a thick covering over the outside of the carcass is necessary before marbling occurs. The average consumer apparently does not appreciate that marbling is associated with higher quality, or, if he does, he considers that the waste fat he must buy to get it makes the cost more than it is worth to him. This selection for leaner cuts is reflected all along the line to the producer. The fat on the carcass has other functions besides imparting flavor and perhaps tenderness to the lean. It protects the carcass from time of slaughter to consumption. Being dry, it decreases the growth of bacteria and molds; it prevents excessive drying and becomes hard in the cooler, thus giving firmness to the carcass and facilitating "aging," which greatly improves flavor and tenderness. Apparently the minimum amount of condition which permits holding of the carcass until it can be merchandised is satisfactory to the average consumer.

The stockman should make every effort to improve the quality of his cattle and to select the thick-fleshed kind which are well developed in rib, loin, and round, for such steers are "good doers" and most economical to produce. Apparently, however, a minimum amount of condition is satisfactory for the bulk of the Coast market trade—a fact adventageous to the producer on account of the great cost of

putting on the extra fat required to produce the higher grades. The production of tender, juicy, and palatable beef without excess fat is a problem justifying attention in the beef industry.

Relation of Grade to Gains and Dressing Percentage.—The average total gain of 23 head of steers, graded "good" as feeders, was 207 pounds per head, or 1.73 pounds daily. Seventeen head graded as "medium" feeders gained on the average 171 pounds each or 1.43 pounds daily, a difference of 0.3 pound per day in favor of the better steers. As shown in table 9, a large number of the steers as feeders were placed in the low good and high medium grades, so that this difference in gaining ability is largely between animals within the limits of a single grade. It demonstrates splendidly the importance of the right type in beef making.

The average dressing percentage of the 14 steers graded "good" as slaughter cattle was 59.40 per cent. The average for the 26 head falling into the medium grade was 58.93, a difference of 0.47 per cent in favor of the good steers. This is a difference in carcass yield of almost 5 pounds per head, which would, at 20 cents per pound, amount to $1.00 per head difference because of higher yield. The fact that most of the steers graded medium were slim in build, and lacked feed capacity, probably accounts for the small difference in dressing percentage.

Yields of Packing House Products.—The following figures should prove interesting to those unfamiliar with packing house procedure, for they give an idea of the items entering into the cost of dressed beef.

	Pounds	Per cent
Total dressed weight	20,936	58.01
Total oil-house fat	780	2.16
Total tallow	1,440	4.00
Total hides	2,825	7.84
Total offal, blood, heads, feet, shrink, etc.	10,054	27.90
Total live weight (40 steers)	36,035	100.00

With steer prices remaining constant, the variation in hide and offal values affects materially the carcass cost.

Calcium and Phosphorus Content of the Ration.—The average daily intake per steer of calcium and phosphorus has been computed from the chemical analysis of the feeds and the average daily ration consumed. It may serve to indicate a certain range of calcium intake which apparently does not influence gains in live weight in yearling

steers over 120–150 day feeding periods. Lots 1, 3, and 4 of the first experiment and lots 1, 2 and 3 of the second are used for this comparison, and the data are shown in table 11.

The gains in lots 1, 3, and 4 of the first experiment were almost identical. Lots 1 and 4 had practically the same calcium intake, 3½ times that of lot 3. Apparently an intake of CaO as low as 0.21 per cent of the total ration and a ratio of P_2O_5 to CaO of 5:1 did not influence the rate of gain.

In the second experiment the ration of alfalfa and rolled barley (lot 1) produced slightly better gains than the other lots. Since the

TABLE 11

DATA ON CALCIUM AND PHOSPHORUS IN RELATION TO GAINS IN LIVE WEIGHT

		Average weight, steers	Average daily gain	CaO, daily intake	P_2O_5, daily intake	CaO, per cent of total ration	P_2O_5, per cent of total ration
		pounds	*pounds*	*pounds*	*pounds*	*per cent*	*per cent*
First experiment	Lot 1	706	1.99	0.14	0.15	0.73	0.78
	Lot 3	709	2.03	0.04	0.21	0.21	1.12
	Lot 4	707	2.00	0.135	0.21	0.72	1.12
Second experiment	Lot 1	817	1.78	0.21	0.15	0.94	0.66
	Lot 2	803	1.51	0.05	0.20	0.23	0.94
	Lot 3	810	1.61	0.134	0.20	0.63	0.94

CaO intake in lot 3 was over 0.6 per cent of the ration, the advantage of lot 1 can hardly be attributed to calcium intake. The difference between lots 2 and 3, as previously stated, is more logically explained by individuality of the steers than by the calcium content of the rations.

In these experiments, the amount of roughage fed was fairly high. When calves are fed heavy concentrate rations (twice as much concentrates as roughage is commonly fed), and a roughage low in calcium, the percentage would be reduced to perhaps less than half that of the low calcium lots shown in table 10. Since the calf, growing rapidly in skeleton, has a relatively higher requirement for mineral than older cattle, the intake would probably be below the minimum requirement for most economical gains. Roughage with lower calcium content than the wild oat hay used in the present experiments, i.e., 0.26 per cent and 0.28 per cent for the first and second trials, respectively, is not commonly encountered. The barley, however, contained only one-fourth as much calcium as the wild oat hay. In all probability, therefore, calcium does not become a limiting factor in economical gains even with low calcium roughage unless the quantity consumed is restricted by heavy concentrate feeding.

SUMMARY

1. Wild oat hay and rolled barley, when fed with sufficient cottonseed meal to supply the necessary protein, are almost equal to alfalfa and rolled barley in the production of gains and finish.

2. Good quality alfalfa hay contains about 12 per cent digestible protein, while wild oat hay contains about 4 per cent, or a difference of 8 per cent. When 10 pounds of wild oat hay are substituted in the daily ration for a like amount of alfalfa, the difference in protein intake is approximately 0.8 of a pound. Two pounds of cottonseed meal are required to make up this difference in protein. Practically the same is true of other grain hays. Good red oat or barley hay might be expected to have a higher value than wild oat hay, because of the greater amount of grain which they usually contain.

3. The addition of calcium carbonate in the form of ground oyster shell did not increase the efficiency of a ration of wild oat hay, rolled barley, and cottonseed meal.

4. Feeding of chopped wild oat hay and molasses did not produce greater gains or finish than long hay. There was no waste of hay when chopped hay was given, and the molasses replaced approximately an equal quantity of barley.

5. Equal parts of alfalfa hay and wild oat hay seemed no more efficient than either kind of hay alone.

6. The addition of cottonseed meal to a ration of alfalfa hay and rolled barley increased neither gains nor finish. The cottonseed meal in combination with alfalfa has some advantages in producing a sleek appearance.

7. The wide variation of steers within the lots made small differences in average gains insignificant.

8. A calcium oxide intake as low as 0.21 per cent of the total ration did not appear to limit gains.

9. Dehorning under favorable conditions prevented gains in weight for a period of about 15 days. Cattle intended for finishing as yearlings should be dehorned while calves.

10. The higher the grade of cattle, the more likely they are to return a profit from intensive feeding with high priced feeds. Poor quality cattle gain less, yield a lower percentage of carcass, and cannot be carried to so high a degree of finish, economically, as the better grades.

11. Most of the Pacific Coast carcass demand for shop trade appears to be for a medium to light weight carcass, carrying only enough fat to keep in the coolers until it can be merchandized, and carrying a minimum of kidney fat. High yield of rib, loin, and round cuts is desired by the retail butcher. Cattle yielding a high per cent of valuable cuts are also the kind which develop rapidly and economically. The finish desired is much more economical to produce than the higher finish required to secure top prices in mid-western markets.

12. Local feed prices can be applied to the amounts of feed required to produce 100 pounds of gain, and the cattleman can therefore estimate the cost of finishing under his own conditions. Table 3 is best for this purpose, because dehorning during the feeding period made feed consumption in relation to gain abnormally high.

The following example shows the method of using data from table 3 to estimate feeding costs and necessary selling price and margin.

Assume that feeder steers cost $10.00 per cwt., wild oat hay $12.00 per ton, barley $35.00 per ton, and cottonseed meal $45.00 per ton.

The feed required to produce 100 pounds of gain, using table 3, lot 3: barley 345 pounds, cottonseed meal 89 pounds, and wild oat hay 485 pounds.

345 pounds barley @ 1.75 cents per pound	$6.04
89 pounds cottonseed meal @ 2.25 cents per pound	2.00
485 pounds wild oat hay @ 0.60 cents per pound	2.91
Cost of feed required for 100 pounds gain	$10.95

Then, assuming an initial weight of 600 pounds, a total gain of 300 pounds to finish the steers, and a 3 per cent shrink, the selling weight would be 900 pounds minus 27 pounds, or 873 pounds.

Initial cost per steer	$60.00
Cost of 300 pounds gain (3 x $10.95)	32.85
Interest, labor, etc. (estimated)	6.00
Total cost	$98.85

Total cost divided by selling weight ($98.85 ÷ 873 pounds) = $11.32, the necessary selling price per cwt. to break even. The necessary margin is the selling price minus the purchase price ($11.32 minus $10.00), or $1.32 per cwt. The necessary margin to break even will vary usually between $1.00 and $2.50 per cwt., depending on initial weight and price of feeders and the feed prices.

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